Information Science

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MY ASSIGNED TASK was to comment on the broad topic: "New sciences, technologies, and media—impact on education for librarianship (or libraries)." It may be no surprise that my choice of emphasis from this wide spectrum is "information science." And rather than attempting to cover the waterfront in a half-hour, I am limiting myself still further, by emphasizing some aspects of the "interface" between librarianship and information science, where I believe the action is going to develop in the coming years.

The letters and announcements regarding openings for information science faculty that I see from library schools in the United States and abroad make it clear that the topic, discipline, or interdiscipline, if you will, has come of age in the academic marketplace. The "specifications" for openings vary widely, however, so much so that it is obvious that there are startling differences in the way that "information science" is perceived in different environments. At one end of the spectrum are those who consider "information as a phenomenon worthy of study in its own right"; at the other end are those who want someone capable of teaching the use of the OCLC terminal, for example, as a part of the basic cataloging course. In between are those who wish the prospective faculty member to address computer programming, library automation, systems analysis, statistics, networking, simulation, and/or communications (tele- or otherwise).

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The announcements and letters also reveal another dimension—regarding the extent of change in curriculum. On the one hand, are those who, for the first time, are venturing "outside" of librarianship as conventionally defined, and wish only to have a single "survey" course taught in "information science," with the candidate required to "double in brass," so to speak, by teaching one or more of the usual core subjects such as administration, resources, reference, or technical services. Then there are some who wish to have the new faculty member, alone, to teach a set of "information science" courses. Finally there are those who plunged into the field earlier and now wish to add depth and breadth through their new faculty acquisition.

One can classify these curricula as:

(1) Committed to established librarianship—wishing only to exhibit that they are "with it" by having a single item (course) in the catalog as "proof."

(2) Committed to established librarianship—but worried they may be left behind, and wishing to "test the water" by an initial commitment to a full faculty slot.

(3) Committed to one or more aspects of information science—desiring to develop greater strength.

(4) Committed to teaching and scholarly research at a fundamental level—examining the basic character of the information transfer (communication) process in libraries *and* other information exchange environments.

Graduates of the various programs exhibit in skills and knowledge the level of commitment of the schools in which they have received their training, leading to some difficulties when they attempt to find their way in the job marketplace.

It appears useful therefore to attempt to structure, or describe, the programs in terms of "exit competencies" which the various programs may have as objectives for their graduates. These competencies fall into three broad classifications:

(1) Literacy
(2) Operational functionality
(3) Research functionality

(1) *Literacy*

Three categories are suggested under "literacy": word recognition; taxonomy; and fundamental processes.

(a) *Word recognition:* this is the minimal level, at which words and terms may be recognized and defined, but not necessarily with a full appreciation of their significance.

(b) *Taxonomy:* this is the level at which the words and terms are understood with regard to interrelationships among them as well as to established librarianship; at this level the component activities comprising information science may be sensed.

(c) *Fundamental processes:* this is the level at which concepts, principles, processes, and component disciplines become clear, leading to the ability to read some of the literature with comprehension.

(2) *Operational Functionality*

Again, three categories are suggested for "operational functionality": operation; analysis; and design.

(a) *Operation:* this is the level at which participation in the operation of an ongoing information system becomes possible, with ability to perform one or more of the functions or unit operations of the system.

(b) *Analysis:* at this level it is possible to employ existing criteria and measures for evaluating the performance of systems with regard to individual functions or unit operations.

(c) *Design:* this is the level at which interrelationships among individual functions or unit operations are understood, particularly with regard to the effects that can be produced with alternative arrangements.

(3) *Research Functionality*

Here again, there are three categories for "research functionality": evaluation; quantitative approaches; and research methodology.

(a) *Evaluation:* at this level it becomes possible to develop tests and measures for evaluation of systems, their components (particularly the human component), and their interrelationships. Also involved is the ability to establish

feedback mechanisms and to analyze and interpret the results of feedback, leading to the establishment of new procedures and processes which will lead to predictable outcomes.

(b) *Quantitative approaches:* this is the level at which precise and sensitive understanding of measures becomes possible, with appropriate instruments able to be designed.

(c) *Research methodology:* at this level there is an understanding of the full range of research methods and of problem analysis, with the ability to select the appropriate method(s) for a given problem that is to be addressed, and the development of a testable hypothesis. Also involved is the ability to analyze and interpret data, and to relate the results to the support of the hypothesis.

Given these levels of "exit competencies" which are developed here, these are some of the questions that are frequently asked by concerned library science students and faculty. Most of these questions exhibit a feeling that the computer is the dominant factor in "information science":

1. Do I really need to know how to program a computer?
2. How much mathematics do I need, to be able to program a computer?
3. Is "information science" content best taught in separate courses, or related to conventional library science courses?
4. How much "hands-on" experience with computers is really needed?

While questions such as these are not necessarily the ones the information scientist might consider the most appropriate, they are symptomatic of some issues that are important.

It is frequently stated that one does not need to understand the principles of the internal combustion engine in order to be a skillful operator of an automobile. When this statement is made in the context of information science education for librarians, I infer that it means:

1. I do not wish to understand the principles of computing, only how the computer may be employed to solve library problems.

2. I, myself, do not wish to program a computer; rather I wish to employ specialists who would perform that task.

Many of today's graduates of library schools will probably be able to conclude a full professional career without ever being obliged to write a computer program. But few will escape the impact of computers in the libraries in which they will work. This does not mean that every library will have its own computer, although some will assert that minicomputers (as prices keep diminishing) will find their way into a large percentage of libraries. Rather it means that the computer will be a factor in budgeting, accounting, shared cataloging, etc., at least through a library system, consortium or network. The librarian who does not understand computer principles will be obliged to accept as appropriate whatever is provided, without the ability to offer meaningful feedback for change or adjustment. Returning to the analogy of the automobile, we are all well aware of the ways in which accidents occur, inefficient performance goes unnoticed, and inappropriate and costly repairs are made—frequently as a result of the lack of even minimal knowledge on the part of the owner/driver. Similarly with computers, the library which is impacted by the computer may not be well served (particularly regarding "human values") unless the professional librarians have some understanding of its principles. Perhaps one should use the term "computer literacy" to describe the level of understanding that should be a minimum.

It is difficult for most to comprehend computer principles without having some personal involvement with computer programming. So I would see considerable benefit from such involvement. The typical introductory courses offered by computer science departments are not usually effective in this regard, often serving to confuse and frustrate rather than to be helpful. So it is frequently necessary to develop a specially designed course (or courses) for this purpose, with exercises and applications relevant to library science.

Exposure to principles is important as well when computer specialists are employed by the librarian, or computer or systems salesmen are encountered. The establishment of specifications of what is to be accomplished and the evaluation of the product require more than a "sixth sense" on the part of the supervisor, since otherwise there may be misunderstandings, or worse. Unrealistic or unrealized objectives may be avoided, and realizable opportunities otherwise neglected may be addressed.

There is a common fear with regard to the requirement for a mathematics background. While such a background is generally useful and wholesome, it is possible to provide painless (mathematics-free) instruction in computer principles and even programming. The "bedside" manner of the instructor becomes critical here: one may find it useful to introduce logical principles and the theory of sets without "telegraphing" what is being done—naming what has been done only after the fact, when learning has been accomplished and it is obvious to the student that it is not so hard after all.

There are some aspects of the field that benefit greatly from "hands-on" experience. The Information Bank of the New York Times; the ERIC data bases; as well as other computerized data bases (e.g., OCLC): these services are impacting libraries more and more. Many "data bases" are becoming increasingly available in non-library environments through commercial services such as Lockheed and SDC. It is hard to be a reference librarian without knowledge of these services—particularly when the patron knows how to utilize them and the librarian does not. Hands-on experience in phrasing questions seems to be a necessary part of the armament of most librarians, but also a fundamental understanding of the principles, lest vendors sell a bill of goods, or promise unrealistic results in the heat of competitive marketing.

I once felt that training in this field should only be provided in separate coursework. Today I am not so sure, since an integrated experience in cataloging (cum OCLC), reference (cum data bases) can provide a better learning environment for many students. A problem arises when the teacher of the conventional course may not be sufficiently au courant to handle the instruction effectively, or may be too threatened to permit a specialist to intrude in the classroom to provide for team teaching. Worst of all is when the teacher prefers to neglect the augmentation.

We can now leave the computer area per se and introduce two other "subjects" that are considered by some to be "information science": (1) quantitative methods, and (2) systems analysis.

(1) *Quantitative Methods:* Just as librarians are expected to be literate, so are they expected today to be "numerate." The need to be guided by past performance, the attention to evaluation, the increasing pressure to plan and relate to budget dilemmas; all these suggest that an understanding of probability and statistics should be a part of the armament of librarians. Just as

with courses in computer programming, these courses are frequently better taught with special attention to library-related problems, lest the bridge between theory and practice be neglected.

(2) *Systems Analysis:* The analysis (and design of systems) benefits from a formal experience. At the risk of sounding prescriptive, this instruction should not be limited to "flow charting" as is done in some schools, but rather should require exposure to the entire range of theory—including the behavioral aspects, involving an understanding of how to deal with human resistance to change when new systems are to be initiated. Some like this subject to be taught in connection with "administration" where there is an obvious relationship. Others prefer to interface it to computer-related subjects.

Moving from the area of coursework, there are several core areas of research in which information science tools are being applied to library problems.

1. *Resource Sharing and Simulation*

The ability for a group of heterogeneous libraries to share resources is considered by many to be conceptually appealing, theoretically sound, and technically possible. The unanswered questions are: (1) Will it work in an operational environment? (2) Is it economically feasible? (3) What effect will it have on the policies, practices, and services of the participating libraries? and (4) What is the optimum size and composition of a library network to effectively share resources? In an attempt to investigate these unanswered questions, the University of Pittsburgh embarked upon the design of an experimental regional resource sharing library network with six participating institutional libraries who have agreed to join the network (financed by a grant from the Buhl Foundation). The libraries in these institutions differ radically in terms of staff size, patron population, size of holdings, acquisition policies and practices, budgets, and many other characteristics.

This library network is being designed and will be tested in an operational environment with each of the members utilizing a network computer facility for acquisitions, cataloging, interlibrary loans, management information, union list of holdings, and accounting data. In addition, the network is to serve patrons for searching a

union catalog for purposes of identifying items that exist in the network and to facilitate interlibrary loans. One of the principal design parameters was to include all the major library functions and to determine the interrelationships between the various functions and the effect of these relationships on the functioning of the network.

The most difficult problem in attempting to design such a library network is that there are many variables related in an unknown manner. Before attempting to formulate a design of the network, it was necessary to understand how these variables would affect the operation of the network under varying conditions so that economic and technical costs and benefits could be assessed. In addition, it was felt that the participating members might be able to utilize this data in formulating policies and procedures in utilizing the network.

A computer simulation has been constructed in connection with our network program, which accepts user defined inputs, generates values based upon representative mathematical distributions; processes these values according to the logical/mathematical model; and produces outputs that represent the behavior of the system under the conditions established by the values assigned to the variables. To simulate a variety of conditions or alternatives, it is only necessary to vary the inputs representing the desired conditions. The outputs represent how the system behaved under the established conditions. The outputs are then analyzed to determine how the changed conditions affected the behavior of the system.

2. *Cost-Benefit Model of Library Operations in Terms of Use*

I have a personal bias, which I should state at the start. My only criterion for judging the effectiveness of an acquisitions program is the use of the materials acquired. It is obvious to me that it is "wrong" to purchase an item that is never used. But it is not possible to make that judgment decisively because all one can assert is that an item has not been used until now. The question that remains open is whether a use yet to be made may or may not be of sufficient importance to have justified its purchase.

At the time an item becomes available for purchase, one cannot predict with certainty how frequently, if ever, it will be used. Nevertheless, judgments are made, in the real world, because there is never enough money to buy everything. So the question to be raised is: Did a judgment to buy result in use—until now?

An investigation of use of books and monographs suggests the

possibility that a significant percentage of acquisitions is used very little or not at all. It also suggests which materials might not have been purchased, which might have better been purchased cooperatively (in a resource sharing enviroment), and which are good candidates for weeding.

Lest you believe from these comments that I believe information science is bounded by computers on the north, statistics on the south, and has not east or west—I would assert that the field must be undergirded with behavior studies—in a major thrust we seek to investigate human behavior in the information seeking mode.

I have reported on several research activities to illustrate how a few aspects of "information science" are being applied to practical library problems. Simulation, modeling, and statistics are being used as important tools in connection with library network design, resource sharing decisions, and even book selection. Scientific method is beginning to remove some of the "art" in making the difficult decisions in libraries.

It appears to me that it is unfair to our students to permit them to leave our programs without these tools, which I am confident they will need to survive professionally. As a minimal statement, I believe that they will not have the opportunity to become leaders in the profession unless we arm them with the "tools of the trade," so to speak.

In connection with the preparation of this article, I read the most generally assigned texts for "core" courses in library science. In the main, these texts do not reveal fundamental changes, to reflect the considerable changes of the last decade or so. The information science aspects, where they are covered at all, are "pasted on"—without development of the "interface."

For example, I mentioned earlier the research on use, and the resource sharing network—I know this *must* have an influence on acquisition policy and practice—and yet the current texts do not make this clear.

Am I alone in this thinking?